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CHEMICAL & ENGINEERING

NEWS

PROCESS CONTROL

Faster, smaller, more integrated sensors

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Cover: Foxboro's Spectrum control system work station

CHEMICAL & ENGINEERING NEWS

Volume 62, Number 23
CENEAR 62 (23) 1–64
ISSN 0009-2347

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Business

Overall profitability of U.S. chemical companies in 1983 was almost the same as in 1982; likewise, smaller, more specialized firms did better than the larger commodity makers. **Page 17**

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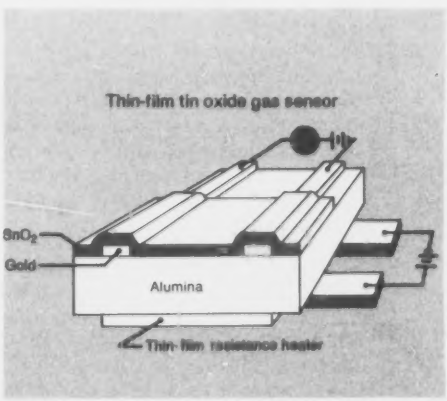

News Focus

The next revolution in process control will be development of smaller, faster sensors. **Page 7**

Chemical Profitability Changed Little in 1983

Average profit margin for 36 chemical companies surveyed remained at 4.3%; specialty chemical firms again led rankings

William J. Storck, C&EN New York

Overall profitability of U.S. chemical firms changed little last year from 1982, based on data gleaned from annual reports of the 36 largest chemical companies. (For the purpose of this C&EN survey, chemical companies are defined as having 40% or more of total sales in chemicals, with chemicals as the single largest product category.)

Analysis of these data shows that average profit margin for the 36 companies remained at 4.3%, return on investment stayed at 3.2%, return on assets dropped to 4.2% from 4.3% in 1982, and return on year-end stockholders' equity remained at 8.8%.

Even though several individual companies improved in these profitability measures during the year—and conversely, others weakened—the lack of change in the group as a whole probably reflects that, economically, both years had a poor half: the second half of 1982 and the first half of 1983. With that similarity, the increasing profits and profitability of second-half 1983 still could not overcome the weak performance of these measures in the first half of the year.

For the year, gains in earnings were pretty well matched by gains in sales, total assets, stockholders' equity, and return on investment (current assets plus gross plant).

The top companies in overall profitability

1. Lawter International
2. International Flavors
3. Nalco Chemical
4. Great Lakes Chemical
5. Chemed
6. Petrolite
7. Lubrizol
8. Rohm & Haas
9. Loctite
10. Ethyl

As was the case in 1982, smaller, more specialized firms dominated the profitability rankings for 1983, although their dominance was not so complete as it has been in the past. In 1983, some of the larger firms, though still heavily involved in specialty chemicals, also ranked high.

Profit margins at U.S. chemical companies held at 4.3% in 1983

Rank 1983	Rank 1982		Profit margin[a] 1983	Profit margin[a] 1982
1	2	Lawter International	15.9%	12.5%
2	1	International Flavors	14.8	14.1
3	3	Freeport-McMoRan	11.5	11.1
4	5	Nalco Chemical	10.8	10.0
5	6	Great Lakes Chemical	10.5	9.7
6	15	Lubrizol	8.1	5.9
7	10	Loctite	7.9	7.3
8	6	Petrolite	7.7	9.7
9	22	Rohm & Haas	7.5	4.1
10	4	First Mississippi	6.9	10.4
11	11	Air Products	6.7	6.7
12	16	Ethyl	6.6	5.7
13	11	Chemed	6.4	6.7
14	19	PPG Industries	6.3	4.7
15	17	Monsanto	6.2	5.4
16	24	Hercules	5.7	3.7
17	9	International Minerals	5.4	7.5
18	14	Liquid Air	5.2	6.1
18	13	Morton Thiokol	5.2	6.2
20	23	American Cyanamid	4.7	3.8
21	28	Pennwalt	4.6	2.6
22	32	Witco Chemical	3.8	2.3
23	27	Olin	3.7	2.9
24	35	Celanese	3.6	0.2
25	28	H. B. Fuller	3.2	2.6
26	30	Stepan Chemical	3.0	2.5
27	19	Essex Chemical	2.9	4.7
28	25	Union Carbide	2.8	3.4
29	31	Crompton & Knowles	2.7	2.4
29	34	Reichhold Chemicals	2.7	0.9
31	21	National Distillers	2.6	4.3
31	18	W. R. Grace	2.6	5.2
33	26	Dow Chemical	2.5	3.2
33	33	Williams Cos.	2.5	1.8
35	—	Baker Industries	0.4	def
—	8	Stauffer Chemical[b]	def	6.2
		AVERAGE	4.3%	4.3%

a After-tax income, excluding extraordinary and nonrecurring items as a percentage of sales. b Stauffer's results for fiscal year ended Sept. 30, 1983, are being compared with results for calender year 1982. def = deficit.

Return on investment stayed flat at 3.2% last year

Rank 1983	Rank 1982		Return on investment[a] 1983	Return on investment[a] 1982
1	2	Lawter International	16.1%	13.2%
2	3	International Flavors	12.7	12.4
3	1	Chemed	12.1	14.0
4	4	Nalco Chemical	11.5	11.1
5	7	Great Lakes Chemical	8.5	6.7
6	6	Loctite	8.2	7.7
7	5	Petrolite	7.7	11.0
8	8	Lubrizol	7.5	6.0
9	10	Ethyl	6.8	5.5
10	10	Morton Thiokol	6.7	5.5
11	22	Rohm & Haas	6.4	3.7
12	26	Hercules	5.8	3.3
13	19	H. B. Fuller	5.6	3.8
14	23	Witco Chemical	5.4	3.5
15	23	PPG Industries	4.7	3.5
16	18	Freeport-McMoRan	4.6	3.9
16	19	Crompton & Knowles	4.6	3.8
18	33	Reichhold Chemicals	4.2	1.5
19	19	Monsanto	4.1	3.8
20	26	American Cyanamid	4.0	3.3
21	29	Pennwalt	3.9	2.4
22	23	Air Products	3.5	3.5
23	9	First Mississippi	3.4	5.8
23	17	Liquid Air	3.4	4.0
25	28	Stepan Chemical	3.3	2.8
26	13	International Minerals	3.1	4.9
26	16	National Distillers	3.1	4.5
28	15	Essex Chemical	2.9	4.6
29	32	Olin	2.6	2.1
29	12	W. R. Grace	2.6	5.4
31	35	Celanese	2.5	0.1
32	31	Union Carbide	1.8	2.2
33	30	Dow Chemical	1.7	2.3
34	34	Williams Cos.	1.1	1.0
35	—	Baker Industries	0.3	def
—	14	Stauffer Chemical[b]	def	4.7
		AVERAGE	3.2%	3.2%

a Earnings excluding extraordinary and nonrecurring items as a percentage of current assets plus gross plant. b Stauffer's results for fiscal year ended Sept. 30, 1983, are being compared with results for calendar year 1982. def = deficit.

Individually, the most profitable chemical company in the U.S. last year, with a first-place ranking in all four profitability measures, was the smallest company in the group—Lawter International, a Chicago area-based maker of pigments and compounds primarily for printing inks and paints, with 1983 sales of $90 million.

Other companies among those with the highest overall profitability rankings also tended to be smaller, quite specialized companies—International Flavors & Fragrances, Nalco Chemical, Great Lakes Chemical, Chemed, and Petrolite. It is not until seventh place that what could be called a medium-sized company—Lubrizol—can be found. Ranking eighth is Rohm & Haas, a larger, more diversified firm, but one still heavily involved in high-value-added products. Loctite ranks ninth, followed by Ethyl, which, like Rohm & Haas, is diversified but heavily involved in specialties. Overall profitability rankings are figured simply by adding the relative rankings in each of the four

Return on assets declined slightly to 4.3%

Rank 1983	Rank 1982		Return on assets[a] 1983	Return on assets[a] 1982
1	1	Lawter International	18.9%	15.6%
2	2	International Flavors	14.9	14.6
3	4	Nalco Chemical	14.5	13.9
4	2	Petrolite	10.6	14.6
5	6	Great Lakes Chemical	10.5	8.1
6	8	Lubrizol	9.5	7.4
7	16	Rohm & Haas	9.4	5.5
8	5	Chemed	8.8	10.1
9	7	Loctite	8.0	7.9
10	12	Ethyl	7.6	6.1
11	24	Witco Chemical	7.1	4.5
12	21	Hercules	6.9	4.7
13	9	Morton Thiokol	6.8	6.5
14	21	PPG Industries	6.4	4.7
14	19	Freeport-McMoRan	6.4	5.0
16	26	H. B. Fuller	6.1	4.2
17	15	Monsanto	6.0	5.6
18	25	American Cyanamid	5.4	4.4
19	33	Reichhold Chemicals	5.2	1.9
20	30	Pennwalt	5.1	3.2
21	27	Crompton & Knowles	5.0	4.0
22	20	Air Products	4.9	4.8
23	18	Liquid Air	4.5	5.1
24	28	Stepan Chemical	4.3	3.3
25	35	Celanese	4.1	0.2
25	11	International Minerals	4.1	6.3
27	28	Olin	3.9	3.3
28	14	First Mississippi	3.7	5.9
29	23	National Distillers	3.4	4.6
29	17	Essex Chemical	3.4	5.2
31	9	W. R. Grace	3.2	6.5
32	31	Union Carbide	2.4	2.9
33	31	Dow Chemical	2.3	2.9
34	34	Williams Cos.	1.2	1.3
35	—	Baker Industries	0.3	def
—	12	Stauffer Chemical[b]	def	6.1
		AVERAGE	4.2%	4.3%

a Earnings excluding extraordinary and nonrecurring items as a percentage of total assets. b Stauffer's results for fiscal year ended Sept. 30, 1983, are being compared with results for calendar year 1982. def = deficit.

Return on stockholders' equity remains at 8.8%

Rank 1983	Rank 1982		Return on equity[a] 1983	Return on equity[a] 1982
1	3	Lawter International	25.6%	19.1%
2	1	Chemed	21.5	33.5
3	3	Nalco Chemical	20.3	19.1
4	5	International Flavors	19.9	18.8
5	9	Great Lakes Chemical	16.8	13.6
6	23	Rohm & Haas	15.6	9.3
7	19	Witco Chemical	15.4	10.0
8	17	H. B. Fuller	15.0	10.5
9	2	Petrolite	14.7	20.8
10	11	Morton Thiokol	14.3	12.6
11	18	Lubrizol	13.7	10.3
12	14	Ethyl	13.6	11.5
13	10	Loctite	12.8	12.8
14	24	PPG Industries	12.6	9.1
15	16	Freeport-McMoRan	12.3	11.3
16	25	Hercules	11.7	8.6
17	6	Essex Chemical	11.6	18.0
18	33	Reichhold Chemicals	10.9	4.1
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20	21	Monsanto	10.6	9.7
21	14	Air Products	10.4	11.5
21	25	American Cyanamid	10.4	8.6
23	35	Celanese	10.2	0.4
24	30	Pennwalt	9.4	6.7
25	28	Crompton & Knowles	9.2	7.4
26	7	First Mississippi	9.1	16.0
27	20	Liquid Air	8.5	9.8
27	31	Olin	8.5	6.6
29	13	International Minerals	7.9	12.1
30	8	W. R. Grace	7.3	14.5
31	27	National Distillers	6.9	7.9
32	29	Dow Chemical	5.4	6.8
33	32	Union Carbide	5.1	6.0
34	34	Williams Cos.	4.6	2.9
35	—	Baker Industries	0.9	def
—	12	Stauffer Chemical[b]	def	12.3
		AVERAGE	8.8%	8.8%

a Earnings excluding extraordinary and nonrecurring items as a percentage of year-end stockholders' equity. b Stauffer's results for fiscal year ended Sept. 30, 1983, are being compared with results from calendar year 1982. def = deficit.

categories of profitability measurement.

Within the rankings of the four profitability measures, considerable movement occurred between 1982 and 1983. In the profit margin listing, for example, only three of the companies retained the same ranking in 1983 as in 1982. Of the others, 20 moved up in rank, and 13 declined. For the return-on-investment ranking, six retained the same rank, 19 advanced, and 11 moved down. In the ranking of return on assets, three companies remained at the same rank, 18 improved, and 15 declined. And for return on equity, two retained the same ranking, 21 moved up, and 13 fell back.

Lawter, the first-place company in all categories, ranked first in 1982 only in return on assets, but moved up from second in both profit margin and return on investment and from third in return on equity.

But there was much greater movement for other firms. Rohm & Haas probably improved the most overall, jumping to ninth place in profit margin, with 7.5%, from 22nd place in 1982 with 4.1%. Its 6.4% return on investment raised it to 11th rank in 1983 from 22nd in 1982 with 3.7%; a 9.4% return on assets brought it to seventh place from 16th the year before with 5.5%; and a 15.6% return on equity boosted it to sixth place from 23rd in 1982 with 9.3%.

Other companies also posted strong improvements in some but not all categories. For instance, Reichhold Chemicals, long an industry laggard, moved up five places to 29th in profit margin in 1983, but in return on assets it moved up 14 places to 19th. And in both return on investment and return on equity it increased its rank 15 spots to 18th place in both cases. Thus, Reichhold in 1983, far from being a trailer, has moved solidly into the middle of the pack.

Others showing healthy increases in at least some categories include Hercules, Witco Chemical, Celanese, Lubrizol, and H. B. Fuller.

It was not all forward movement in the rankings, however. In the worst such case, Stauffer Chemical, with a deficit in 1983, weakened its profitability position, effectively taking it out of the rankings in which the year before it ranked eighth in profit margin, 12th in both return on assets and return on equity, and 14th in return on investment.

Another large decline struck W. R. Grace, which fell 13 places to 31st in profit margin, 17 places to 29th in return on investment, 22 spots to 31st in return on assets, and 22 places to 30th in return on equity.

Other large drops in ranking in the four profitability measures were registered by the fertilizer and mineral companies—First Mississippi and International Minerals & Chemicals—and at National Distillers, Essex Chemical, and Liquid Air.

Because data for this survey derive from annual reports, a few companies with fiscal years ending in the second or third quarter of last year, such as Air Products, International Minerals, and Loctite, were not able to report the full effect of the recovery in the latter part of the year in their annual figures. Thus, their results might have been higher if they had been reported for the calendar year.

Whereas the chemical industry's profitability went virtually nowhere last year, it looks as if 1984 will be a different story. The momentum that started in the latter part of 1983 has continued, and, barring catastrophe, profitability will be up significantly this year. In C&EN's latest survey of earnings of 30 major chemical companies (C&EN, May 14, page 10), profit margins—the one profitability measure that can be gauged quarterly—rose to 5.7% in the first quarter from just 3.8% in first-quarter 1983. □

Specialty chemicals: mixed bag for growth

The specialty chemical business will continue to be more attractive than commodity chemicals. In general, profits will be higher, sales growth will be faster, and specialties will be less cyclical than commodities.

That's part of the analysis of the U.S. specialty chemical industry that Frode Nordhoy, president of Strategic Analysis Inc., Reading, Pa., brought to Toronto, where he presented it as a guide for his Canadian counterparts at a meeting on specialty chemicals sponsored by the Corpus Chemical Group.

What Nordhoy told them was that many specialties will continue to outperform other segments of the chemical industry in both sales growth and profitability. Specialties will offer many opportunities to companies already in the business as well as to companies trying to diversify into them.

However, some segments of the specialty chemical business will be much more attractive than others, he says. Despite the glamorous-sounding overtones of specialties, some segments of the business already are mature; others are aging.

In addition, competition will become more intense in the marketplace. And rapidly changing technologies will present some companies with insurmountable problems.

Nordhoy pegs last year's U.S. market for 30 identifiable classifications of specialty chemicals at $40.6 billion. But the business, he points out, is very fragmented. Agricultural chemicals, the largest individual segment with 1983 sales of $5.5 billion, account for only about 14% of the total. The top five segments, which in addition to agricultural chemicals include oil field chemicals, industrial coatings, specialty lubricants, and industrial and institutional cleaners, account for almost half of total sales. On the bottom end, half (15) of the segments have less than a 2% share of the total. That, says Nordhoy, is fragmentation.

Despite this fragmentation, specialty chemicals are big business. Almost half of Nordhoy's 30 segments had 1983 sales of $1 billion or more.

For the remainder of the decade, U.S. specialty chemical sales will increase faster than gross national product, as they historically have. Assuming that GNP will maintain an average 3- to 4%-per-year growth pace, Nordhoy says that total U.S. specialty chemical sales will increase an average 5% annually. That will

Electronic chemicals will be top performer

Specialty chemical	U.S. sales[a] ($ millions) 1983	1990	% of total, 1983[b]	% of total, 1990[b]	Average annual growth 1983–90
Oil field	$ 4,200	$ 6,800	10.3%	11.7%	7%
Agricultural	5,500	6,700	13.5	11.5	3
Electronic	2,500	6,100	6.2	10.5	13
Industrial coatings	4,000	4,900	9.8	8.4	3
Specialty lubricants	3,300	3,600	8.1	6.2	2
Industrial & institutional cleaners	2,900	3,500	7.1	6.0	3
Specialty polymers	1,800	3,300	4.4	5.7	9
Diagnostics	1,500	3,000	3.7	5.2	10
Adhesives & sealants	1,600	2,600	3.9	4.5	7
Plastic additives	1,600	2,300	3.9	3.9	5
Lubricant additives	1,500	1,900	3.7	3.3	3
Food additives	1,200	1,600	3.0	2.7	4
Photographic	1,000	1,600	2.5	2.7	7
Catalysts	1,200	1,600	3.0	2.7	5
Water management	950	1,300	2.3	2.2	5
Textile	780	1,000	1.9	1.7	4
Metal finishing	570	700	1.4	1.2	3
Biocides	520	690	1.3	1.2	4
Cosmetics	520	650	1.3	1.1	3
Specialty surfactants	420	640	1.1	1.1	6
Rubber	470	620	1.2	1.1	4
Reagents	370	520	0.9	0.9	5
Explosives	410	500	1.0	0.9	3
Paper	340	450	0.8	0.8	4
Refinery	260	370	0.6	0.6	5
Paint & coating additives	380	350	0.9	0.6	3
Mining	340	300	0.8	0.5	3
Fuel additives	210	280	0.5	0.5	4
Printing ink	170	210	0.4	0.4	3
Foundry	130	170	0.3	0.3	3
TOTAL	**$40,640**	**$58,250**	**100.0%**	**100.0%**	**5%**

a 1983 dollars. b Column may not add to 100% because of rounding. **Source:** Strategic Analysis Inc.

Earl M. Muetterties Memorial Symposium
University of California, Berkeley
June 22–23, 1984

A special symposium honoring the late Prof. Earl Muetterties, sponsored by the Materials & Molecular Research Division of Lawrence Berkeley Laboratory and the Chemistry Department of the University of California, Berkeley, will be held at Berkeley on June 22–23.

The program features 12 outstanding contributors to the field of inorganic chemistry, with areas of research representing those in which Muetterties made significant contributions. Speakers are Fred Basolo, Northwestern U; John Bercaw, Caltech; John Bradley, Exxon; Lawrence Dahl, U of Wisconsin; Harry Gray, Caltech; Fred Hawthorne, UCLA; Richard Holm, Harvard; Stephen Lippard, MIT; Richard Schrock, MIT; Edward Solomon, Stanford; Henry Taube, Stanford; Patricia Watson, Du Pont.

Registration will be limited to 200 participants. The fee of $100 will include a banquet, mixer, and lunches. Room accommodations at one of three hotels nearby will be arranged by the LBL Conference Coordination Group.

Complete the information below, including $100 registration fee payable to: UC Regents, and send to Muetterties Symposium, Dept. of Chemistry, U.C. Berkeley, Berkeley, Calif. 94720, by June 12. For more information call (415) 642-6710.

Name _____ Daytime phone _____

Affiliation _____

Address _____

put them close to the $60 billion mark by 1990.

Nordhoy points out, however, that many segments of the specialty chemical industry are maturing and will grow at rates only close to that of GNP. These include several of the largest segments of the business, such as agricultural chemicals, industrial coatings, specialty lubricants, and industrial and institutional cleaners.

On the other hand, he has tabbed several segments of the industry that will outperform the 5%-per-year average growth rate through 1990. For instance, electronic chemicals, he says, will be the top performer. With an estimated growth rate of 13% annually, sales of electronic chemicals will nearly triple from last year's $2.5 billion to $6.1 billion in 1990. That's good enough to pull electronic chemicals from sixth to third on Nordhoy's list of specialty chemical segments.

Nordhoy includes in electronic chemicals the materials used to make semiconductor devices, printed circuit boards, and such passive components as resistors, capacitors, and hybrid networks. This segment was hit hard by the recession, but it has rebounded to a double-digit growth rate.

Diagnostic chemicals will sport an average 10%-per-year growth rate through 1990, doubling sales volume from last year's $1.5 billion. The development of monoclonal antibody-based immunodiagnostics will mean a rapid growth market for immunodiagnostics, especially for the nonisotopics. Automated instruments and small clinical analyzers for doctors' offices also will expand the market. Meanwhile, the general aging of the U.S. population will have a significant—and positive—impact on the diagnostic chemicals market.

Specialty polymers will be another fast-growing segment of the U.S. specialty chemicals business. Nordhoy says that the growing use of specialty polymers and their modified compounds as structural replacements for metals in the automotive, aerospace, and construction industries will stimulate demand for these products.

As a result, sales of specialty polymers will grow an average 9% per year, reaching $3.3 billion by 1990. Not only will resin producers benefit from this growth, but so will the specialty firms that modify engineering thermoplastics with reinforcing agents such as carbon and glass fibers.

Nordhoy also believes that the oil field chemicals business will grow at an above-average 7%-per-year rate through 1990. Although this business took a severe beating in 1982 and depends directly upon the supply, demand, and price of crude oil, the long-term trend is strong.

The oil rig count may never hit the 4500 level again, but Nordhoy

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sees it growing from its present low level of about 2300. This will pull along with it a higher demand for drilling mud. Meanwhile, the long-term trend toward deeper wells will increase demand for high-performance chemicals. And a pickup in enhanced recovery will boost demand for oil field chemicals.

Sales of specialty adhesives and sealants also will enjoy a 7% average annual growth rate through 1990. These products will benefit from changes in substrates to plastics and higher grades of paper, both of which will require new adhesives. Further growth will take place in the automotive and aerospace industries as plastics and composites gain wider acceptance.

To improve performance, adhesives will continue to replace traditional fasteners. Nordhoy expects particularly strong growth for anaerobics, cyanoacrylates, waterborne systems, and hot melt systems.

If 7 to 13% growth rates don't sound exciting enough, Nordhoy has identified several "high-growth niches" that can boast of expected growth rates of up to 40% annually. In the electronic chemicals segment, for instance, plasma processing materials and materials for photovoltaic cells are growing at much higher rates than the average for electronic chemicals. Nordhoy estimates 40%-per-year growth for these particular products over the next several years.

The market for plasma processing materials is now very small—only several million dollars. But these materials are replacing traditional acids and etching materials. Many experts, says Nordhoy, believe that this technology is the only practical way to etch submicron geometries into the silicon-based devices of the future.

The market for photovoltaic cell materials also is small. Nordhoy puts this market at about $40 million now, but he expects it to exceed $500 million by the end of the decade. These materials, he says, represent an embryonic market opportunity that few companies have noticed.

Despite these and other rapidly growing uses, all is not clear sailing in the chemical specialties business. Some market segments already are mature. Competition is getting tougher as new domestic and foreign companies get into the act. Some companies can't keep pace with the rapidly changing technology. And government regulation has an adverse impact on some specialty businesses.

But what are problems for some companies are opportunities for others. As a result, Nordhoy expects more major chemical companies to increase their stake in specialty chemicals, both through acquisition and internal programs.

Earl Anderson, New York

Some high-growth areas will far outpace the specialty chemical segments of which they are a part

Segment	High-growth area	Average annual growth 1983–90 for segment	Average annual growth 1983–90 for high-growth area
Electronic chemicals	Plasma processing material	13%	40%
	Material for photovoltaic cells	13	40
	Conformal coatings	13	20
	Conductive coatings	13	20
Cosmetic chemicals	Ultraviolet absorbers	3	8
Reagent chemicals	Biochemicals	5	9
Industrial & institutional cleaners	Cleaners for fast-food restaurants	3	8
Specialty lubricants	Semisynthetic and synthetic cutting fluids	2	10
Catalysts	Hydrotreating catalysts	5	10
Water management chemicals	Light industrial, institutional, and commercial businesses	5	10
Diagnostic chemicals	Nonisotopic immunoassay reagents	10	20

Source: Strategic Analysis Inc.

Announcing DuPont's four newest "Idea Intermediates."

The newest additions to the family of DuPont "Idea Intermediates," shown on the opposite page, are:

DBA Dibasic Acid

$HOOC(CH_2)_n COOH$

n = 2,3,4

Sodium Styrene Sulfonate

$CH_2=CH-C_6H_4-SO_3Na$

Triphenylboron

$B(C_6H_5)_3$

Triisopropyl borate

$B[OCH(CH_3)_2]_3$

If you would like more information on any of these four products, write on your company letterhead to: DuPont Company U.S.–Room G40109, Wilmington, DE 19898; EUROPE–P.O. Box CH-1211, Geneva 25, Switzerland; JAPAN–11-39 Akasaka 1-chome, Minato-ku, Tokyo 107.

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